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EDITORIAL

We heartily indorse the recent circulars issued by the Department of Agriculture and Natural Resources wherein a more general use of corn as a staple article of diet in the Philippines and also as feeds for domestic animals is advocated. Its nutritive value, higher than that of rice, together with the fact that its price is over thirty per cent lower, speaks well for corn; and we see in this important crop a satisfactory substitute for rice in case the supply of the latter should fall below the demand.

A considerable proportion of Filipinos are rice eaters. They have been so much used to this diet for centuries that to most of them food and rice are synonymous. They do not consider themselves as having eaten any real meal unless rice forms a portion of their menu. To this class of people, attempts at introducing corn as a substitute for rice are likely to be met at first with discouragingly indifferent response, if not with opposition. But with the right kind of propaganda, such as the Department of Agriculture and Natural Resources is spreading, and efficient demonstration work showing in the most practical manner possible the various ways by which corn may be used, not as a mere substitute for rice and other foods alone, but also as a palatable and highly nutritious article of food by itself, we believe that the people can be gradually made to overcome their prejudices and induced to use larger quantities of corn regularly on their tables.

The activity of the primary, intermediate and high schools of the Bureau of Education in the direction of corn demonstration also deserves comment. Such demonstrations are always attended by large crowds of interested people; and the effect they have caused in the way of popularizing corn is quite marked in many places. We would, however, venture to make two suggestions, which, we believe, would add greatly to the effectiveness of such demonstrations:

1. That more recipes be introduced which are closely allied to the forms of foods common to the natives, and less

COLLEGE NOTES

Professor E. B. Copeland, formerly dean of this college, has located himself with his family at Chico, California, U. S. A., where he owns and is managing an extensive farm which is mainly devoted to rice culture.

Dr. W. H. Weston, plant pathologist of the U.S. Department of Agriculture, has been detailed to the Philippines to make investigations on the powdery mildew of corn (*Sclerospora maydis*), a severe and rather common disease of this crop in this country and elsewhere. Dr. Weston is now temporarily stationed at this college, where he is being extended all the facilities of our laboratories.

Cases of smallpox have appeared in Los Baños and the neighboring municipalities, resulting in a number of deaths.

Dr. José S. Villacorta, physician of the College of Agriculture, claims to have devised a new and very effective method of applying smallpox vaccine. Details of the new method will be discussed elsewhere in a paper, of which the manuscript is now being prepared by Dr. Villacorta.

The University authorities called several meetings of the land owners whose farms have been purchased for the experiment station by right of eminent domain. The petty difficulties which arose with the owners are now practically adjusted, mainly through the timely intercession of Governor Juan Cailles, of Laguna, to whom this college owes a debt of gratitude.

Mr. Elias H. Pañganiban, '15, assistant in agronomy, will be transferred to the Department of Chemistry, where he will serve as assistant, effective July first.

Messrs. Mauricio David and Prudencio Ruiz, graduates of the Philippine School of Arts and Trades, have been appointed assistants in blacksmithing and in carpentry, respectively, effective on their first day of duty.

Mr. Eduardo Quisumbing, '18, has been appointed assistant in botany, effective April eighth.

Mr. Pedro D. Clariza, a graduate of the College of liberal Arts, has been appointed assistant in mathematics in this college, effective April twenty-third.

Mr. Valente Villegas, instructor in animal husbandry, has been transferred to the Department of Agronomy, with the same rank, effective May fourth.

Mr. Fructuoso Aquino has been appointed chief mechanician of this college, vice Joaquin Ruiz de Arana.

Mr. Mariano B. Raymundo, instructor in economics, has tendered his resignation effective June third.

EDITORIAL

(*Continued from page 249*)

of pies, biscuits and others which the majority of the people use only occasionally as a luxury on their tables.

2. That in the preparation of the various ingredients to be used in demonstration work, utensils that are more commonly found in native homes be used in preference to imported articles of foreign manufacture. The use of more familiar native utensils will accomplish much toward driving the point home to the ordinary native spectator. Furthermore, the use of readily available ingredients only will lend an air of immediate possibility to the new cookery recommended.

The Minimum Bordeaux Application for the Control of Hemileia

By Emilio Macasaet Africa

Thesis presented for graduation from the College of Agriculture, No. 88

INTRODUCTION

The principal obstacle to the development of the coffee industry in the Philippines is the prevalence of the very destructive leaf rust (*Hemileia vastatrix* Berkeley et Broome). The protection of coffee trees from the ravages of this fungus disease by spraying with Bordeaux mixture has been so successful in other countries that its use is no longer an experiment, and there appears to be no reason why this remedy can not be used here with equal success.

The purpose of the present work is to determine the minimum amount of Bordeaux mixture to use most economically, as well as effectively, and the right time to spray coffee trees, for if continually treated with standard solution of Bordeaux, the increase in production that may be occasioned thereby would be overbalanced by the cost of materials and time employed.

The rate of production of coffee in the Philippines at present is very far below what it used to be at a certain period in the past. A few years ago the cultivation of *arabica* coffee was an important industry in certain provinces of the Philippines, notably in Batangas; but when the *Hemileia* broke out in these regions, the coffee industry was soon practically wiped out of existence. The very rapid decrease in coffee production since the time the disease was first found in the coffee plantations of the Philippines is shown by the following figures: In 1864 (1) the export of coffee from Manila was 37,845 piculs and in 1874 was 45,842 piculs. In 1872 the value of coffee exported was $869,000,000 and in 1873, $1,126,000,000. By 1890 (2) the production of coffee in certain towns, Lipa in particular, was the source of considerable wealth, and coffee ranked fourth as an export trade of the Islands, the figures reaching 7.4% of the total export.

On the basis of this past brief period of successful coffee raising, we firmly believe that, as soon as the more important diseases and pests of coffee shall have been effectively combated, the industry can be re-established in the Islands, and probably on a much more extensive scale. In many places, the natural conditions existing in the way of ideal altitudes, climates, and soil conditions appear to be very favorable for this crop. We have the mountain slopes ranging from 1000 to 4000 feet above sea level, deep valleys and vast plateaus which cover thousands of square miles; much of them are still uncultivated.

By way of comparison, Java is far ahead of the Philippines in coffee production. The former country lies at the same distance south of the equator as Mindanao does north; both islands are well within the tropics. Java excels the Philippines in coffee culture, not because of more favorable climatic or soil conditions, but because the Javanese have always aimed at building up coffee culture into a national business and have worked hard to realize this end. The Dutch planters were interested in the maintenance of their plantations in spite of all difficulties and so they brought scientific and careful treatment to bear upon the problems of blight and fungus disease. *Hemileia* once became so destructive to coffee in Java that from a surplus of 165,000,000 lb., the production fell to almost nil. But the Javanese planters have now re-estab-

lished their coffee industry so that it often reaches an annual export of nearly 40,000,000 lb., and their coffee commands some of the highest prices in the markets of the world. If the Filipinos should give as serious attention to the improvement of coffee cultivation as the Dutch planters did in Java, the Philippines might, with proper attention, be able to produce a considerable part of the $75,000,000 to $80,000,000 worth of coffee imported into the United States annually.

PREVIOUS WORK ON COFFEE SPRAYING

G. L. Tawei (3) says that in Porto Rico more attention has been given to coffee diseases than to any other special subject. In combating root diseases in trying to find out methods of preventing the spread of the disease, he finally discovered that the use of sprays had a definite effect. Spraying should be done in order to check the rapidly growing mycelium. He suggests the adding of some adhesive to the Bordeaux, such as borax or starch mixture.

J. C. Cameron, (4) referring to the destructive fungus, *Hemileia vastatrix*, says that the fungus is very bad on the leaves of coffee plant in India. A planting experiment in the gardens of Mysore was severely attacked by the fungus, which was temporarily checked by burning every infected leaf. Spraying with Bordeaux mixture also checked the spread of the disease. He emphasizes the necessity of better cultivation and proper fertilization of the crop. In this way the plants are made more healthy and are able to withstand fungus attack to a greater degree.

P. S. J. Cramer (5) points out that on account of the influence of *Hemileia vastatrix* in Java, the product of coffee under government control fell from an average of 92,333 piculs to 81,741 piculs within five years from 1880 to 1885. He strongly recommends spraying with Bordeaux mixture. He also advises the growing of resistant varieties in order to check the spread of the disease.

F. D. Luistro's experiment on spraying (6) was undertaken at Los Baños and at Lipa. At the close of his experiment at Los Baños, he found that the sprayed trees showed no sign of infection whatever. On the other hand, the unsprayed trees appeared to be badly infected with *Hemileia*, the infection varying from 5% to 99%. In his work at Lipa he found that the sprayed trees appeared entirely free from *Hemileia*, except two trees which had 0.2% and 0.3% of their leaves infected. He noticed also that the loss in leaves of the unsprayed trees varied from 50% to 100%, and that this loss could be prevented largely by spraying. Mr. Luistro pointed out that due to the destruction done by *Hemileia* to coffee at Lipa and at Los Baños, the average loss of production was 69%. This loss, he states, can be prevented by spraying. At Lipa he found that the increase in yield due to spraying was 83%. He noticed also that coffee trees at Lipa were more susceptible to *Hemileia* than those at Los Baños. Also, the trees in Lipa were infected earlier than in Los Baños.

MAKING AND SPRAYING BORDEAUX MIXTURE

Bordeaux mixture is the standard spraying mixture used to protect plants from fungus diseases (7). It was introduced into the United States from Europe in 1887 by the United States Department of Agriculture.

There are but three ingredients used in its preparation: water, lime and copper sulphate. The water acts as a vehicle, the lime neutralizes the caustic action

of the copper sulphate and also makes the mixture adhesive and the copper sulphate is the chemical that prevents the growth of the spores of the disease. These three substances are combined in various proportions, depending upon the kind of plant to be treated. For coffee and other plants of similar character, the preparation is made from the formula as follows:

Copper sulphate	3 lb.
Stone lime	5 lb.
Water	50 gallons

The copper sulphate can be dissolved in two different ways, by using cool water and also by using hot water, the latter being much more rapid. In dissolving copper sulphate, iron or tin vessels should not be used, for copper sulphate will attack the iron and the resulting compound will spoil the Bordeaux mixture. A wooden bucket or a demijohn will make the best container. One of the most important facts to remember in the preparation of Bordeaux mixture is that the lime should be properly slaked. Carefully slake the 5 lb. of stone lime, using only sufficient water to form with the lime a thick paste. Then dilute it up to 25 gallons. The 3 lb. of copper sulphate should be placed in a wooden bucket with hot water, and when completely dissolved, more water added up to 25 gallons. The copper sulphate and milk of lime are now ready to mix. Two persons are necessary for the operation. The contents of each bucket should be well stirred, and the contents of the two simultaneously poured into a third receptacle, the two streams coming together in a uniform mixture. This prepared solution is the stock solution. In our work the stock solution is diluted to three different strengths: ¾ strong, ½ strong, and ¼ strong.

There are several ways of testing in order to insure a good Bordeaux mixture. One is by the use of litmus paper. It is advisable that the Bordeaux be slightly alkaline, for, if the solution has an acid reaction, it is likely to injure the foliage of the plant. Another test is by the use of a 10% solution of ferricyanide of potassium. If a few drops of Bordeaux mixture be added to some of this ferricyanide of potassium solution and no change of color occurs, the mixture is safe for use; if a cloudy reddish brown discoloration appears, more lime should be added to the mixture.

In order to get good results with Bordeaux mixture several points are to be borne in mind:

(1) A good type of nozzle must be used in order that the spray may be misty, and not jet-like.

(2) Use only pure lime, free from all air-slaked particles.

(3) Use care in slaking the lime.

(4) Be accurate in all weights and measurements.

(5) Properly mix together the two solutions.

(6) Make application at the proper time.

(7) Spray thoroughly.

Care should also be taken that the Bordeaux mixture is made as directed, exactly in the proportions given, since a carelessly prepared solution may cause serious injury to the plants.

PLAN OF EXPERIMENTS

In connection with the present work duplicate experiments were planned and carried out on "native" coffee (*C. arabica*) at San Antonio, Los Baños, and on caracolillo coffee (*C. arabica*) on the college farm. These experiments had for their objects the finding out of the effect of spraying with different strengths of Bordeaux mixture and the right time of application on coffee trees.

In order to determine the minimum amount of spraying materials and the minimum number of applications which will do the work effectively, the plan outlined below was followed:

Six trees were sprayed with Bordeaux mixture diluted to ¾ strength, every 2 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ¾ strength, every 3 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ¾ strength, every 4 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ½ strength, every 2 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ½ strength, every 3 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ½ strength, every 4 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ¼ strength, every 2 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ¼ strength, every 3 weeks.
Six trees were sprayed with Bordeaux mixture diluted to ¼ strength, every 4 weeks.

COFFEE TREES USED AT LOS BAÑOS

The trees used in Los Baños were almost uniform in age, soil conditions, size and shade in which they grew.

During the course of the experiment, weekly observations pertaining mostly to the work of *Hemileia* were made. Spraying was begun on June 3, 1916, and continued until February 10, 1917.

The number of leaves of each individual tree was counted and recorded. The first counting of leaves was on July 15, 1916; the second, on October 14, 1916, and the last, on February 10, 1917.

The trees used were located in three different places in the barrio of San Antonio, Los Baños, Laguna. At each point 24 trees were under experiment.

The first 24 trees were called Lot I.
The second 24 trees were called Lot II.
The third 24 trees were called Lot III.

Each lot was divided into three groups: A, B, and C. Each group contained eight trees, of which six were sprayed and the other two left unsprayed.

The following tables show the strength of Bordeaux mixture used for the six sprayed trees in each group and the intervals of time between spraying:

Lot I-A —Solution used diluted to ¾ strong every 2 weeks.
Lot I-B —Solution used diluted to ¾ strong every 3 weeks.
Lot I-C —Solution used diluted to ¾ strong every 4 weeks.
Lot II-A —Solution used diluted to ½ strong every 2 weeks.
Lot II-B —Solution used diluted to ½ strong every 3 weeks.
Lot II-C —Solution used diluted to ½ strong every 4 weeks.
Lot III-A—Solution used diluted to ¼ strong every 2 weeks.
Lot III-B—Solution used diluted to ¼ strong every 3 weeks.
Lot III-C—Solution used diluted to ¼ strong every 4 weeks.

LOT I-A

Effect of Spraying on Yield

Harvesting of the ripe berries was begun on October 7, 1916, and continued until December 10, 1916. The harvested ripe berries were weighed, fermented, cleaned and sorted into good and poor beans. A complete record of weight of beans was kept. To make a fair comparison in yield of the sprayed and the unsprayed trees, I found the average yield of one unsprayed tree and then multiplied this by six. The yield of 6 unsprayed trees was used throughout in different lots in comparison with the yield of 6 sprayed trees.

Sound beans produced by six sprayed trees	4243 gm.
Sound beans produced by six unsprayed trees	150 gm.
Increase due to spraying or 96.4% increase	4093 gm.

Cost of Spraying

For each application for six trees 54.92 grams of lime and 32.35 grams of copper sulphate were used. Estimating

that two men could spray 170 trees in one day, each man working ten hours a day, the cost of each application for 170 trees was:

1.53 kg. of lime at ₱0.022	₱	0.034
0.95 kg. of copper sulphate at ₱0.384.		0.353
Two men at ₱0.80 a day		1.60
Total cost of one spraying of 170 trees	₱	1.99
Cost on one spraying	₱	1.99
Cost of 19 sprayings		37.81
Average increase in yield per tree		697.1 gm.
Average increase in yield per 170 trees		118.5 kg.
Value of yield of 170 trees at ₱0.94 a kg.	₱	111.39
Cost of spraying of 170 trees 19 times.		37.81
Net profit from spraying 19 times	₱	73.58

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until about August 6, 1916, there was no sign of infection on sprayed trees, and only a slight infection of the unsprayed trees.

On October 14, 1916, a sharp contrast was observed. The average per cent of infected leaves on the sprayed trees was found to be 0.227% and 11.55% on the unsprayed ones. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 0.47% and on the unsprayed trees 54.16%. The loss in leaves was determined, and it was found that the sprayed trees had an average of 14.8% and the unsprayed trees 67.94%. (Leaves that dropped because of age were included.)

LOT I-B

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	2545 gm.
Sound beans produced by six unsprayed trees	150 gm.
Increase due to spraying or 90.1%	2395 gm.

Cost of Spraying

For each application for six trees 44.94 grams of lime and 26.9 grams of copper sulphate were used.

1.273 kg. of lime at ₱0.022	₱	0.028
0.761 kg. of copper sulphate at ₱0.384		0.29
Two men at ₱0.80 a day		1.60
Total cost of one spraying of 170 trees	₱	1.918
Cost of one spraying	₱	1.92
Cost of 13 sprayings		24.96
Average increase in yield per tree		399 gm.
Average increase in yield per 170 trees		67.83 kg.
Value of yield of 170 trees at ₱0.94 a kilo	₱	63.76
Cost of spraying 170 trees 13 times		24.96
Net profit from spraying 13 times	₱	38.80

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until about July 15, 1916, there was no sign of infection on sprayed or unsprayed trees. On August 14, 1916, both the sprayed and the unsprayed trees were slightly infected.

On October 14, 1916, a sharp contrast was observed. The average per cent of infected sprayed leaves was found to be 1.30% and on the unsprayed trees, 11.55%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 2.31% and on the unsprayed trees, 54.16%.

The loss in leaves was determined. It was found that the sprayed trees had lost an average of 19.97% and the unsprayed trees, 67.94%.

LOT I-C

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	261 gm.
Sound beans produced by six unsprayed trees	150 gm.
Increase due to spraying or 42.52%	111 gm.

Cost of Spraying

For each application for six trees 44.94 grams of lime and 26.9 grams of copper sulphate were used.

1.273 kg. of lime at ₱0.022	₱	0.028
0.761 kg. of copper sulphate at ₱0.384		0.29
Two men at ₱0.80 a day		1.60
Total cost of one spraying of 170 trees	₱	1.918
Cost of one spraying	₱	1.92
Cost of 10 sprayings		19.20
Average increase in yield per tree		18.5 gm.
Average increase in yield per 170 trees		3.2 kg.
Value of yield of 170 trees at ₱0.94 a kilo	₱	3.00
Cost of spraying 10 times	₱	19.20
The loss incurred in spraying 10 times	₱	16.20

EFFECT OF SPRAYING ON HEMILEIA

From June 8, 1916, until about June 17, 1916, there was no sign of infection on sprayed, as well as on unsprayed, trees. On July 24, 1916, both the sprayed and the unsprayed trees were slightly infected.

On October 14, 1916, a sharp contrast was observed. The average per cent of infected leaves on the sprayed trees was found to be 1.2% and on the unsprayed trees 11.55%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on sprayed trees was 4.28% and on the unsprayed trees, 54.16%.

The loss in leaves was determined. It was found that the sprayed trees had an average of 21.59% loss and the unsprayed trees, 67.94%.

LOT II-A

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	909.8 gm.
Sound beans produced by six unsprayed trees	150.0 gm.
Increase due to spraying or 81.2%	759.8 gm.

Cost of Spraying

For each application for six trees 29.95 grams of lime and 17.95 grams of copper sulphate were used.

0.848 kg. of lime at ₱0.022	₱	0.019
0.508 kg. of copper sulphate at ₱0.384		0.195
Two men at 80 centavos a day		1.60
Total cost of one spraying of 170 trees	₱	1.814
Cost of one spraying	₱	1.814
Cost of 19 sprayings		34.46
Average increase in yield per tree		126.6 gm.
Average increase in yield per 170 trees		21.59 kg.
Value of yield of 170 trees at ₱0.94 a kilo	₱	20.19
Cost of spraying 170 trees 19 times		34.46
The loss incurred in spraying 19 times	₱	14.27

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until about July 1, 1916, there was no sign of infection on sprayed trees and only a slight infection on the unsprayed trees. On August 6, 1916, both the sprayed and the unsprayed trees were slightly infected. On October 14, 1916, a sharp contrast was observed. The average per cent of infected leaves on sprayed trees was found to be 0.54% and on the unsprayed trees 14.55%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 2.18% and on the unsprayed trees 57.08%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 16.18% and the unsprayed trees, 80.11%.

LOT II-B

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	674.4 gm.
Sound beans produced by six unsprayed trees	150.0 gm.
Increase due to spraying or 77.72%	523.4 gm.

Cost of Spraying

For each application for six trees 29.96 grams of lime and 17.95 grams of copper sulphate were used.

0.848 kg. of lime at ₱0.022	₱ 0.019
0.508 kg. of copper sulphate at ₱0.384	0.195
Two men at ₱0.80 a day	1.600
Total cost of one spraying of 170 trees	₱ 1.814
Cost of one spraying	₱ 1.814
Cost of 13 sprayings	23.580
Average increase in yield per tree	84.23 gm.
Average increase in yield per 170 trees	14.83 kg.
Value of yield of 170 trees at ₱0.94 a kilo	₱ 13.94
Cost of spraying 13 times	23.58
Loss incurred in spraying 13 times	₱ 9.64

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until about June 15, 1916, there was no sign of infection on either sprayed or unsprayed trees. On August 6, 1916, both the sprayed and the unsprayed trees were slightly infected.

On October 14, 1916, a sharp contrast was observed. The average per cent of infected leaves was found to be 4.31% and on the unsprayed trees 14.55%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 6.86% and on the unsprayed trees, 57.08%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 25.25% and the unsprayed trees, 80.11%.

LOT II-C

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	197.5 gm.
Sound beans produced by six unsprayed trees	150.0 gm.
	42.5 gm.

Here the sprayed trees produced 42.5 grams more than the unsprayed trees.

Cost of Spraying

0.848 kg. of lime at ₱0.022	₱ 0.018
0.508 kg. of copper sulphate. at ₱0.384	0.195
Two men at ₱0.80 a day	1.60
Total cost of one spraying of 170 trees	₱ 1.813
Cost of one spraying	₱ 1.813
Cost of 10 sprayings	18.13

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until about June 15, 1916, there was no sign of infection on either sprayed or unsprayed trees. On August 6, 1916, both the sprayed and the unsprayed trees were slightly infected.

On October 14, 1916, a sharp contrast was observed. The average per cent of infected leaves was found to be 4.64% and on the unsprayed trees 14.55%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 8.56% and on the unsprayed trees 57.08%.

The loss in leaves was determined and it was found that the sprayed trees had an average loss of 30.03% and the unsprayed trees, 80.11%.

LOT III-A

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	352.1 gm.
Sound beans produced by six unsprayed trees	150.0 gm.
Increase due to spraying or 56.2%	202.1 gm.

Cost of Spraying

For each application on six trees 14.98 grams of lime and 8.98 grams of copper sulphate were used.

0.423 kg. of lime at ₱0.022	₱ 0.009
0,253 kg. of copper sulphate at ₱0.384	0.097
Two men at ₱0.80 a day	1.60
Total cost of one spraying of 170 trees	₱ 1.706

Cost of one spraying	₱ 1.706
Cost of 19 sprayings	32.41
Average increase in yield per tree	33.7 gm.
Average increase in yield per 170 trees	5.73 kg.
Value of yield of 170 trees at ₱0.94 a kilo	₱ 5.39
Cost of spraying 19 times	32.41
Loss incurred by spraying 19 times	₱ 27.02

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until June 15, 1916, there was no sign of infection on either the sprayed or the unsprayed trees. On August 6, 1916, both the sprayed and the unsprayed trees were slightly infected.

On October 14, 1916, a sharp contrast was observed. The average per cent of infected leaves was found to be 4.60% and on the unsprayed trees, 10.41%. At the close of the experiment, Februrary 10, 1917, the average per cent of infected leaves on the sprayed trees was 8.82% and on the unsprayed trees, 55.72%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 32.22% and the unsprayed trees, 82.00%.

LOT III-B

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	201.2 gm.
Sound beans produced by six unsprayed trees	150.0 gm.
Increase due to spraying or 23.9%.	51.2 gm.

Cost of Spraying

For each application on six trees 14.97 grams of lime and 8.8 grams of copper sulphate were used.

0.432 kg. of lime at ₱0.022	₱ 0.009
0.253 kg. of copper sulphate at ₱0.384	0.097
Two men at ₱0.80 a day	1.60
Total cost of one spraying of 170 trees	₱ 1.706
Cost of one spraying	₱ 1.706
Cost of 13 sprayings	22.18
Average increase in yield per tree	8.53 gm.
Average increase in yield per 170 trees	1.45 kg.
Value of yield of 170 trees at ₱0.94 a kilo	₱ 1.36
Cost of spraying 13 times	22.18
Loss incurred in spraying 13 times	₱ 20.82

EFFECT OF SPRAYING ON HEMILEIA

From June 3, 1916, until about June 15, 1916, there was no sign of infection on sprayed or unsprayed trees. On August 6, 1916, both the sprayed and unsprayed trees were slightly infected.

On October 14, 1916, a contrast was observed. The average per cent of infected leaves was found to be 3.65% and on the unsprayed trees, 10.41%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 11.36% and on the unsprayed trees, 55.72%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 35.28% and the unsprayed trees, 82.00%.

LOT III-C

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	20 gm.
Sound beans produced by six unsprayed trees	150 gm.

Here again the sprayed trees produced 130 grams less than the unsprayed trees.

Cost of Spraying

For each application on six trees, 14.97 grams of lime and 8.8 grams of copper sulphate were used.

0.423 kg. of lime at ₱0.022	₱ 0.009
0.253 kg. of copper sulphate at ₱0.384	0.097
Two men at ₱0.80 a day	1.60
Total cost of one spraying of 170 trees	₱ 1.706
Cost of one spraying	₱ 1.706
Cost of 10 sprayings	17.06

EFFECT ON SPRAYING HEMILEIA

From June 3, 1916, until June 15, 1916, there was no sign of infection on either the sprayed or the unsprayed trees. On August 6, 1916, both the sprayed and the unsprayed trees were slightly infected.

On October 14, 1916, both the sprayed and the unsprayed trees were heavily infected. The average per cent of infected leaves was found to be 4.83% and on the unsprayed trees, 10.41%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 26.24% and on the unsprayed trees, 55.72%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 36.33% and the unsprayed trees, 82.0%.

The following series of tables (I-III) shows the comparative effect of spraying on the loss of leaves, on production, and on the work of *Hemileia vastatrix* on coffee trees at San Antonio, Los Baños, Laguna.

Table I—Lot I-A	Trees sprayed with Bordeaux mixture diluted to ¾ strong, every 2 weeks.
Table I—Lot I-B	Trees sprayed with Bordeaux mixture diluted to ¾ strong, every 3 weeks.
Table I—Lot I-C	Trees sprayed with Bordeaux mixture diluted to ¾ strong, every 4 weeks.
Table II—Lot II-A	Trees sprayed with Bordeaux mixture diluted to ½ strong, every 2 weeks.
Table II—Lot II-B	Trees sprayed with Bordeaux mixture diluted to ½ strong, every 3 weeks.
Table II—Lot II-C	Trees sprayed with Bordeaux mixture diluted to ½ strong, every 4 weeks.
Table III—Lot III-A	Trees sprayed with Bordeaux mixture diluted to ¼ strong, every 2 weeks.
Table III—Lot III-B	Trees sprayed with Bordeaux mixture diluted to ¼ strong, every 3 weeks.
Table III—Lot III-C	Trees sprayed with Bordeaux mixture diluted to ¼ strong, every 4 weeks

TABLE I

Native Coffee at San Antonio		Total No. of leaves July 15, 1916	Total No. of leaves Feb. 10, 1917	No. of leaves dropped	% of leaves dropped	Weight in grams of berries	Weight in grams of beans	% of beans	Total No. of Leaves	July 15, 1916 No. of Rusty Leaves	July 15, 1916 % of Rusty Leaves	Oct. 14, 1916 Total No. of Leaves	Oct. 14, 1916 No. of Rusty Leaves	Oct. 14, 1916 % of Rusty Leaves	Feb. 10, 1917 Total No. of Leaves	Feb. 10, 1917 No. of Rusty Leaves	Feb. 10, 1917 % of Rusty Leaves
Sprayed ¾ strong every 2 weeks.	Lot I–A-1	23685	21395	2290	9.66	4093	1370	33.47	23685	0	0	22246	19	0.85	21395	31	.14
	" 2	18814	16510	2304	12.24	4845	1660	34.26	18814	0	0	17213	21	.12	16510	28	.16
	" 3	6895	5993	902	13.08	334	125	37.4	6895	0	0	5201	16	.30	5993	43	.71
	" 4	13762	10585	3177	23.08	1092	375	34.34	13762	0	0	13165	20	.14	10585	59	.56
	" 5	16083	14155	1928	11.98	1518	508	33.46	16083	0	0	15840	28	.18	14155	21	.14
	" 6	4600	3474	1126	24.47	622	202	32.47	4600	0	0	3846	21	.54	3474	38	1.09
Average sprayed					15.75						0			.35			.47
Unsprayed	Check " 7	7690	3208	4482	58.28	659	197	30	7690	0	0	5846	862	14.74	3208	1648	51.37
	Check " 8	6436	1625	4811	74.75	none	none	0	6436	0	0	4200	575	13.69	1625	948	58.32
Sprayed ¾ strong every 3 weeks.	Lot I–B-1	5434	4243	1191	21.91	1966	695	35.3	5434	0	0	5831	20	.34	4243	46	1.08
	" 2	4011	3115	896	22.33	1705	557	32.66	4011	0	0	4432	113	2.54	3115	71	2.27
	" 3	4756	3687	1069	22.47	1266	436	34.43	4756	0	0	4621	63	1.36	3687	89	2.41
	" 4	4070	3334	736	18.08	1063	348	32.7	4070	0	0	4038	17	.42	3334	48	1.43
	" 5	4095	3424	671	16.38	1624	509	31.3	4095	0	0	3891	83	2.13	3424	115	3.32
	" 6	3298	2591	707	21.4	none	none	0	3298	0	0	2413	27	1.20	2591	91	3.51
Average sprayed					20.43						0			1.33			2.30
Unsprayed	Check " 7	3871	927	2944	76.05	none	none	0	3871	0	0	2802	241	8.60	927	513	55.33
	Check " 8	4487	1126	3361	74.90	none	none	0	4887	0	0	2946	113	3.83	1126	685	60.83
Sprayed ¾ strong every 4 weeks.	Lot I–C-1	4544	3390	1154	25.39	none	none	0	4544	3	.066	4023	36	.89	3390	143	4.22
	" 2	3308	2849	459	13.87	295	93	31.5	3308	10	.30	3411	49	1.43	2849	98	3.44
	" 3	3098	2567	531	17.14	78	25	32.05	3098	0	0	3027	31	1.02	2567	188	7.32
	" 4	4300	3048	1252	29.11	none	none	0	4300	10	.23	3891	43	1.10	3048	142	4.65
	" 5	9977	8227	1750	17.54	42	12	28.5	9977	0	0	9442	68	.72	8827	218	2.47
	" 6	6412	5041	1371	21.38	453	131	26.7	6412	18	.28	5689	116	2.03	5041	168	3.33
Average sprayed					20.74						.146			1.2			4.24
Unsprayed	Check " 7	5833	1745	4088	70.08	105	30	28.57	5833	6	.10	3412	609	17.84	1745	841	48.19
	Check " 8	4878	2025	2853	58.48	111	30.5	26.57	4878	2	.041	3871	489	12.63	2025	1131	55.85
Average Unsprayed					64.28						.07			15.23			52.02

TABLE II

Native Coffee at San Antonio		Total No. of leaves July 15, 1916	Total No. of leaves Feb. 10, 1917	No. of leaves dropped	% of leaves dropped	Weight in grams of berries	Weight in grams of beans	% of beans	July 15, 1916 Total No. of Leaves	July 15, 1916 No. of Rusty Leaves	July 15, 1916 % of Rusty Leaves	Oct. 14, 1916 Total No. of Leaves	Oct. 14, 1916 No. of Rusty Leaves	Oct. 14, 1916 % of Rusty Leaves	Feb. 10, 1917 Total No. of Leaves	Feb. 10, 1917 No. of Rusty Leaves	Feb. 10, 1917 % of Rusty Leaves
Sprayed ½ strong every 2 weeks.	Lot II–A-1	6380	5320	1060	16.61	none	none	0	6380	3	.047	6542	29	.44	5320	63	1.18
	" 2	2690	2415	275	10.22	9	2.8	31	2690	1	.037	2385	12	.50	2415	49	2.02
	" 3	4010	3224	786	19.60	1079	379	35.1	4010	2	.049	4878	14	.28	3224	70	2.17
	" 4	6866	5992	874	12.73	1094	355	32.41	6866	0	0	6801	23	.33	5992	185	3.08
	" 5	3940	3349	591	15.00	204	72	35.2	3940	1	.025	3641	13	.35	3349	110	3.28
	" 6	5600	4706	894	15.97	328.5	101	30.7	5600	1	.018	5116	68	1.32	4706	68	1.44
Average sprayed					15.02						.029			.54			2.19
Unsprayed	Check " 7	2705	398	2307	85.28	none	none	0	2705	0	0	1898	149	7.85	398	248	62.31
	Check " 8	2060	266	1794	87.08	none	none	0	2060	13	.63	1002	213	21.25	266	146	54.88
Sprayed ½ strong every 3 weeks.	Lot II–B-1	5160	3167	1993	38.65	55	19	34.54	5160	2	.038	5013	113	2.25	3767	116	3.07
	" 2	3060	1660	1400	45.75	646	222	34.3	3060	79	2.58	3874	231	5.96	1660	185	11.14
	" 3	1534	1372	162	10.55	none	none	0	1534	3	.19	1463	113	7.72	1372	123	8.96
	" 4	7504	4825	2679	35.70	1300	397	30.54	7504	82	1.09	6208	324	6.21	4825	165	3.41
	" 5	5824	3985	1839	31.57	585	18.2	31.1	5824	1	.017	5992	113	1.88	3985	342	8.58
	" 6	4330	3594	736	16.99	58	17.2	30	4330	12	.27	4213	80	1.89	3594	213	5.92
Average sprayed					29.87						.69			4.27			6.84
Unsprayed	Check " 7	7807	1786	6021	77.12	none	none	0	7807	2	.025	5116	218	4.25	1786	903	50.05
	Check " 8	5264	1214	4050	76.93	none	none	0	5264	120	.227	3878	739	19.05	1214	686	56.50
Sprayed ½ strong every 4 weeks.	Lot II–C-1	3364	2258	1106	32.87	107.3	34	31.7	3364	1	.029	3102	132	4.25	2258	190	8.41
	" 2	5980	4085	1895	31.68	160.5	51	31.8	5980	7	.11	5831	331	5.67	4085	170	4.16
	" 3	2986	2188	798	26.72	59	18.5	31.35	2986	10	.33	2128	61	2.86	2188	115	5.25
	" 4	2720	1878	842	30.94	131	39.5	30.15	2720	17	.63	1992	110	5.52	1878	243	12.93
	" 5	4090	2359	1731	42.32	14	4	28	4090	11	.26	3983	267	6.70	2359	231	9.78
	" 6	4772	2905	1867	39.12	none	none	0	4772	0	0	4212	122	2.89	2905	513	17.66
Average sprayed					33.92						.23			4.64			9.70
Unsprayed	Check " 7	3071	743	2328	75.83	none	none	0	3071	12	.39	1891	191	10.10	743	411	55.31
	Check " 8	2315	401	1914	82.67	173	52	30	2315	14	.60	943	221	23.43	401	381	95.01
Average Unsprayed					79.25						.50			16.77			75.16

TABLE III

Native Coffee at San Antonio		Total No. of leaves July 15, 1916	Total No. of leaves Feb. 10, 1917	No. of leaves dropped	% of leaves dropped	Weight in grams of berries	Weight in grams of beans	% of beans	July 15, 1916 Total No. of Leaves	July 15, 1916 No. of Rusty Leaves	July 15, 1916 % of Rusty Leaves	Oct. 14, 1916 Total No. of Leaves	Oct. 14, 1916 No. of Rusty Leaves	Oct. 14, 1916 % of Rusty Leaves	Feb. 10, 1917 Total No. of Leaves	Feb. 10, 1917 No. of Rusty Leaves	Feb. 10, 1917 % of Rusty Leaves
Sprayed ¼ strong every 2 weeks.	Lot III–A-1	6792	4104	2688	39.57	34	10.5	30.8	6798	3	.044	6642	89	1.33	4104	316	7.69
	" 2	3606	2466	1140	32.16	64	20	31.2	3606	0	0	2941	161	5.47	2466	217	8.79
	" 3	4586	3125	1461	31.85	985	311.5	31.6	4586	2	.043	3821	341	8.92	3125	350	11.20
	" 4	3486	2258	1228	35.22	none	none	0	3486	1	.028	2846	128	4.49	2258	206	9.12
	" 5	4426	3190	1236	27.92	6	2	33.3	4426	4	.090	4113	198	4.81	3190	210	6.58
	" 6	3004	2219	785	26.13	25	8.1	32.4	3004	6	.19	2961	174	5.87	2219	223	10.04
Average sprayed					32.14						.0658			5.14			8.90
Unsprayed	Check " 7	1646	338	1308	79.46	none	none	0	1646	23	1.39	1026	84	8.18	338	211	62.42
	Check " 8	2010	474	1536	76.41	none	none	0	2010	38	1.89	1631	206	12.63	474	186	39.24
Sprayed ¼ strong every 3 weeks.	Lot III–B-1	3130	1817	1313	41.94	572	182	31.8	2130	2	.093	3061	118	3.85	1817	182	10 01
	" 2	4036	2845	1191	29.59	none	none	0	4036	1	.024	3914	101	2.58	2845	218	7.66
	" 3	4092	3072	1020	24.92	314	99	31.5	4092	6	.146	4160	98	2.35	3072	302	9.83
	" 4	2348	1467	881	37.52	none	none	0	2348	4	.170	1948	95	4.87	1451	231	15.92
	" 5	2478	1546	932	37.61	none	none	0	2478	1	.04	2105	71	3.37	1546	130	8.40
	" 6	2258	1262	996	44.10	241	84	34.8	2258	6	.26	2148	113	5.26	1262	219	17.35
Average sprayed					35.94						.122			3.71			11.52
Unsprayed	Check " 7	4272	584	3688	86.32	423	113.5	26.8	4272	12	.28	3991	513	12.85	584	341	58.39
	Check " 8	5082	602	4480	88.15	135	27	20.0	5082	8	15	4813	388	8.06	602	386	64.11
Sprayed ½ strong every 4 weeks.	Lot III–C-1	9056	7842	1214	13.40	none	none	0	9056	6	.066	8348	239	2.86	7842	783	9.98
	" 2	3392	1660	1732	51.06	none	none	0	3392	0	0	3102	121	3.90	1660	517	31.14
	" 3	3266	1574	1692	51.80	71	20	28.1	2266	2	.088	3213	218	6.78	1574	482	30.62
	" 4	2384	1357	1027	43.07	none	none	0	2384	8	.33	2181	143	6.55	1357	587	43.25
	" 5	1807	1125	682	37.74	none	none	0	1807	2	.11	1628	98	6.01	1125	410	36.44
	" 6	3204	2384	820	25.59	none	none	0	3204	9	.28	3047	101	3.31	2389	263	11.0
Average sprayed					37.11						.145			4.90			27.07
Unsprayed.	Check " 7	1700	309	1391	81.82	none	none	0	1700	6	.35	946	43	4.54	309	184	59.54
	Check " 8	3841	891	2950	76.80	none	none	0	3841	0	0	2821	211	7.47	891	438	49.15
					81.49						.67			8.95			55.47

TABLE IV

Caracolillo Coffee		Total No. of leaves July 8, 1916	Total No. of leaves Feb. 10, 1917	No. of leaves dropped	% of leaves dropped	Weight in grams of berries	Weight in grams of beans	% of beans	Total No. of leaves	July 8, 1916: No. of Rusty Leaves	July 8, 1916: % of Rusty Leaves	Oct. 7, 1916: Total No. of Leaves	Oct. 7, 1916: No. of Rusty Leaves	Oct. 7, 1916: % of Rusty Leaves	Feb. 10, 1917: Total No. of Leaves	Feb. 10, 1917: No. of Rusty Leaves	Feb. 10, 1917: % of Rusty Leaves
Sprayed ¾ strong every 2 weeks.	Lot I–A-1	396	285	111	28.03	.34	10.8	31.85	396	3	.75	344	6	1.74	285	3	1.05
	" 2	720	580	140	19.44	364.9	127.25	34.87	720	5	.69	666	12	1.80	580	10	1.72
	" 3	954	686	268	28.09	318.5	107.5	33.75	954	3	.31	910	17	1.87	686	7	1.02
	" 4	461	313	148	32.10	113.2	35	30.91	641	6	.93	698	8	1.14	493	11	2.23
	" 5	Dead Aug. 10, 1916.															
	" 6	752	568	184	24.46	52.5	18.1	34.47	752	2	.26	784	13	1.65	568	11	1.93
Average sprayed					26.42									1.64			1.59
Unsprayed	Check " 7	204	40	164	80.39	none	none	0	204	14	6.86	188	45	23.93	40	18	45
	Check " 8	174	24	150	86.20	none	none	0	174	30	17.24	92	54	58.69	24	12	50
Sprayed ¾ strong every 3 weeks	Lot I–B-1	380	293	87	22.89	9	2.8	31.11	380	4	1.05	376	24	6.38	293	8	2.73
	" 2	406	296	110	27.09	82.4	23.6	28.64	406	8	1.97	424	16	3.77	296	11	3.71
	" 3	318	207	111	34.90	39.8	12.5	31.40	318	6	1.88	306	15	4.90	207	5	2.41
	" 4	416	281	135	32.45	34.3	11.3	32.94	416	7	1.68	384	22	5.72	281	10	3.55
	" 5	398	277	121	30.40	475.8	155.5	32.68	398	11	2.76	390	15	3.84	277	6	2.16
	" 6	406	283	123	30.29	440.3	150	34.06	406	6	1.47	418	16	3.82	283	11	3.88
Average sprayed					29.67						1.80						3.07
Unsprayed	Check " 7	296	10	286	96.62	10	3	30.00	296	18	6.08	200	150	75.00	10	8	80
	Check " 8	202	8	194	96.03	none	none	0	204	43	21.07	104	36	34.61	8	5	62.50
	Lot I–C-1	288	214	74	25.69	4	1.2	30.00	288	11	3.81	276	14	5.07	214	8	3.73
	" 2	428	305	123	28.73	16.5	5.15	31.21	428	10	2.33	452	28	6.19	305	16	5.24
	" 3	918	634	284	30.93	97.9	31.5	32.17	918	13	1.41	816	62	7.59	634	15	2.36
	" 4	1126	672	454	40.31	124.8	56	44.87	1126	12	1.06	1004	67	6.67	672	22	3.27
	" 5	372	265	107	28.76	62.5	18.5	29.6	372	4	1.07	380	26	6.84	265	9	3.39
	" 6	645	462	183	28.37	158.6	44.5	28.05	645	11	1.70	864	45	5.20	462	24	5.19
											1.89			6.26			3.86
	Check " 7	181	14	167	92.26	none	none	0	181	18	9.94	192	39	20.31	14	9	64.28
	Check " 8	113	20	93	82.30	none	none	0	113	12	10.61	126	48	38.09	20	14	70
											11.96			41.77			61.96

TABLE V

Caracolillo Coffee		*Total No. of leaves July 8, 1916*	*Total No. of leaves Feb. 10, 1917*	*No. of leaves dropped*	*% of leaves dropped*	*Weight of grams of berries*	*Weight in grams of beans*	*% of beans*	*July 8, 1916*			*Oct. 7, 1916*			*Feb. 10, 1917*		
									Total No. of Leaves	*No. of Rusty Leaves*	*% of Rusty Leaves*	*Total No. of Leaves*	*No. of Rusty Leaves*	*% of Rusty Leaves*	*Total No. of leaves*	*No. of Rusty Leaves*	*% of Rusty Leaves*
Sprayed ½ strong every 2 weeks.	Lot II–A-1	695	477	218	31.36	1.28	35	27.34	695	10	1.44	622	66	10.61	477	6	1.25
	" 2	453	321	132	29.13	76.6	24.5	31.98	453	6	1.32	442	45	10.18	321	7	2.18
	" 3	629	431	198	31.47	118.8	37	31.14	629	14	2.22	684	44	6.43	431	15	3.48
	" 4	556	362	194	34.89	15.89	4.5	28.3	556	9	1.62	526	53	10.07	312	12	3.84
	" 5	307	198	109	35.50	56.3	15.9	28.24	307	8	2.60	272	31	11.39	198	6	3.03
	" 6	355	259	96	27.04	none	none	0	355	4	1.12	324	35	10.80	259	6	2.31
Average sprayed					31.56						1.72			9.91			2.68
Unsprayed	Check " 7	102	12	90	88.23	none	none	0	102	24	23.52	98	35	35.71	12	6	50
	Check " 8	117	8	109	93.16	none	none	0	117	27	23.07	144	44	30.55	8	5	62.5
Sprayed ½ strong every 3 weeks.	Lot II–B-1	455	295	160	35.16	8.5	2.6	30.58	455	12	2.63	414	66	15.94	295	11	3.73
	" 2	328	234	94	28.65	118.6	45	37.94	328	8	2.43	392	41	10.45	234	12	5.12
	" 3	426	293	133	31.22	235	76.9	32.72	426	13	3.05	454	50	11.01	293	22	7.50
	" 4	522	353	169	32.37	474.7	168	35.39	522	7	1.34	594	54	9.09	353	24	6.79
	" 5	373	245	128	34.31	51	16	31.37	373	12	3.21	450	67	14.88	245	23	9.38
	" 6	428	297	131	30.60	63.6	19.1	30.0	428	15	3.5	470	52	11.06	297	26	8.75
Average sprayed					32.05						2.69			12.07			6.88
Unsprayed	Check " 7	185	8	177	95.67	none	none	0	185	16	8.64	158	90	56.96	8	6	75.0
	Check " 8	113	9	104	92.03	14	3.8	27.15	113	10	8.84	160	83	51.87	9	4	44.44
Sprayed ½ strong every 4 weeks	Lot II–C-1	565	375	190	33.62	148.7	44	29.58	565	19	3.36	516	129	25.0	375	38	10.13
	" 2	385	264	121	31.43	58.6	16.5	28.15	385	8	2.07	324	60	18.51	264	19	7.19
	" 3	700	296	404	57.71	193.2	52.2	27.02	700	17	2.43	694	148	21.32	296	22	7.43
	" 4	565	371	194	34.33	324.3	98	30.21	565	28	4.95	690	102	14.78	371	28	7.54
	" 5	968	629	339	35.02	264.5	88	33.27	968	27	2.78	1060	148	13.96	629	37	5.88
	" 6	255	123	132	51.76	4	1.1	27.50	255	12	4.70	248	48	15.32	223	11	4.93
Average sprayed					40.64			29.29			3.38			18.15			7.18
Unsprayed	Check " 7	198	8	190	95.9	none	none	0	198	22	11.11	180	61	33.88	8	5	62.5
	Check " 8	189	14	175	92.59	none	none	0	189	16	8.46	214	43	20.09	14	10	71.43
Average unsprayed					94.25						9.78			26.98			66.96

TABLE VI

Caracolillo Coffee		Total No. of leaves July 8, 1916	Total No. of leaves Feb. 10, 1916	No. of leaves dropped	% of leaves dropped	Weight in grams of berries	Weight in grams of beans	% of beans	July 8, 1916: Total No. of Leaves	July 8, 1916: No. of Rusty Leaves	July 8, 1916: % of Rusty Leaves	Oct. 7, 1916: Total No. of Leaves	Oct. 7, 1916: No. of Rusty Leaves	Oct. 7, 1916: % of Rusty Leaves	Feb. 10, 1917: Total No. of Leaves	Feb. 10, 1917: No. of Rusty Leaves	Feb. 10, 1917: % of Rusty Leaves
Sprayed ¼ strong every 2 weeks.	Lot III–A-1	444	248	196	44.14	140.5	46	32.74	444	12	2.70	456	82	17.98	248	19	7.66
	" 2	266	150	116	43.60	6	1.7	28.33	266	9	3.38	196	33	16.83	150	8	5.33
	" 3	325	180	145	44.61	15	4.8	32.00	325	12	3.69	396	63	15.90	180	15	8.33
	" 4	800	421	379	47.37	340.6	104	30.53	800	11	1.37	840	99	11.78	421	28	6.65
	" 5	908	493	415	45.70	274	87.8	32.04	908	22	2.42	1100	107	9.72	493	23	4.66
	" 6	193	115	78	40.41	48	14.3	29.79	193	2	1.03	174	23	13.21	115	9	7.82
Average sprayed					44.30						2.43			14.23			6.74
Unsprayed	Check " 7	136	14	122	89.70	none	none	0	136	8	5.88	124	80	64.51	14	6	42.85
	Check " 8	200	36	164	82.0	none	none	0	200	13	6.50	218	94	43.11	36	22	61.11
Sprayed ¼ strong every 3 weeks.	Lot III–B-1	Dead Sept. 4, 1916.															
	" 2	434	239	195	44.93	82.2	32.4	39.41	434	15	3.45	452	89	19.69	239	28	11.71
	" 3	518	298	220	42.47	122.3	35.5	29.02	518	13	2.50	538	156	28.99	298	32	10.73
	" 4	493	251	242	49.08	56	16	28.57	493	15	3.04	566	184	32.50	251	34	13.54
	" 5	510	263	247	48.43	27.5	8	29.09	510	6	1.17	520	151	29.03	263	37	14.06
	" 6	466	265	201	43.13	321.6	108.6	33.76	446	27	6.05	446	140	31.39	265	22	8.30
Average sprayed					45.60						3.24			28.32			11.66
Unsprayed	Check " 7	113	12	101	89.38	9	2.5	27.77	113	10	8.84	124	43	34.67	12	7	58.33
	Check " 8	195	10	185	94.87	none	none	0	195	24	12.30	156	69	44.23	10	0	0
Sprayed ¼ strong every 4 weeks.	Lot III–C-1	879	512	367	41.75	87	27	31.03	879	35	3.98	632	169	26.74	512	43	8.39
	" 2	960	464	496	51.66	121	34	28.09	960	28	2.91	914	203	22.21	464	46	9.91
	" 3	780	415	365	46.79	11	3.1	28.18	780	22	2.82	506	128	25.29	415	38	9.15
	" 4	457	225	232	50.76	25	7.2	28.80	457	16	3.50	372	76	20 43	225	29	12.88
	" 5	676	333	343	50.73	51	16	31.37	676	30	4.43	722	220	30.47	333	34	10.21
	" 6	228	114	114	50.0	18	4.9	27.22	228	16	7.01	204	88	43.13	114	18	15.78
Average sprayed					48.61						4.10			28.04			11.05
Unsprayed	Check " 7	234	44	190	81.19	none	none	0	234	24	10.25	214	43	20.09	44	23	52.27
	Check " 8	330	25	305	92.42	none	none	0	330	21	6.36	312	94	30.12	25	16	64.00
Average unsprayed					88.26						8.35			39.45			46.42

TABLE VII

EFFECT OF SPRAYING IN YIELD

Lot No.	*Treatment*	*Sound Beans Produced*		*Increase due to Spraying*		*Value of Yield of 170 trees*	*Cost of Spraying 170 trees*	*Net Profit from Spraying*	*Loss Incurred in Spraying*
		By 6 sprayed trees	*By 6 unsprayed trees*	*For 6 trees*	*For 170 trees*	*at ₱0.94 Kg.*			
Lot I–A	¾ strong every 2 weeks	4243 gms.	150 gms.	4093 gms.	118.5 Kg.	₱11.39	(19 times) ₱37.81	₱73.58	
Lot I–B	¾ strong every 3 weeks	2545 "	150 "	2395 "	67.83 "	63.76	(13 times) 24.96	38.80	
Lot I–C	¾ strong every 4 weeks	261 "	150 "	111 "	3.20 "	3.00	(10 times) 19.20		₱16.20
Lot II–A	½ strong every 2 weeks	909.8 "	150 "	759.8 "	21.59 "	20.19	(19 times) 34.46		14.27
Lot II–B	½ strong every 3 weeks	674.4 "	150 "	524.4 "	14.83 "	13.94	(13 times) 23.58		9.64
Lot II–C	½ strong every 4 weeks	97.5 "	150 "	Here the sprayed trees produced 52.5 gm. less than the unsprayed trees.					
Lot III–A	¼ strong every 2 weeks	352.1 "	150 "	202.1 "	5.73	5.39	(19 times) 32.41		27.02
Lot III–B	¼ strong every 3 weeks	201.2 "	150 "	51.2 "	1.45 "	1.36	(13 times) 22.18		20.82
Lot III–C	¼strong every 4 weeks	20.0 "	150 "	Here the sprayed trees produced 130 gm. less than the unsprayed trees.					

COFFEE TREES ON THE COLLEGE FARM

Another set of experiments was carried out on caracolillo coffee (*C. arabica*) trees near the forestry quarters on the college farm. The trees selected were uniform as to age and soil conditions. They differed slightly in size and shade. The trees were 3½ years old. The plan of the work was just the same as the plan used in Los Baños. The first counting of leaves was on July 8, 1916; the second, on October 7, 1916; and the last, on February 10, 1917. Here the cost of spraying was not computed because the trees were not in full bearing.

LOT I-A

Effect of Spraying on Yield

The harvesting of ripe berries was begun on October 7, 1916, and continued until November 28, 1916. The harvested ripe berries were weighed, fermented, cleaned, and sorted into good and poor beans. A complete record of weight of beans was kept. Of the six sprayed trees in this group, one died, so the comparison was based on five sprayed trees with six unsprayed trees.

Sound beans produced by five sprayed trees	299.55 gm.
Sound beans produced by six unsprayed	14.46 gm.
Increase due to spraying or 95.1%	285.09 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and the unsprayed trees were slightly infected with rust. On July 8, 1916, a sharp contrast was observed. The average per cent of infected leaves on the sprayed was found to be 0.58% and on the unsprayed 11.88%. On October 7, 1916, the average per cent of infected leaves on the sprayed was 1.76%, and on the unsprayed trees 41.35%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 1.58% and on the unsprayed trees, 61.96%.

The loss in leaves was determined and it was found that the sprayed trees had an average loss of 25.54% and the unsprayed trees, 89.28%. (Leaves dropped because of age were included.)

LOT I-B

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	315.7 gm.
Sound beans produced by six unsprayed trees	14.46 gm.
Increase due to spraying or 95.41%	301.24 gm.

EFFECT OF SPRAYING IN HEMILEIA

On June 3, 1916, both the sprayed and the unsprayed trees were slightly infected with rust. On July 8, 1916, a sharp contrast was observed. The average per cent of infected leaves was found to be 1.80% and on the unsprayed 11.88%. On October 7, 1916, the average per cent of infected leaves on sprayed trees was 4.81% and on the unsprayed trees 41.35%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 3.07% and on the unsprayed trees, 61.96%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 29.71% and the unsprayed trees, 89.28%.

LOT I-C

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	156.85 gm.
Sound beans produced by six unsprayed trees	14.46 gm.
Increase due to spraying	142.39 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and the unsprayed trees were slightly infected with rust. On July 8, 1916,

a sharp contrast was observed. The average per cent of infected leaves on the sprayed trees was found to be 1.89% and on the unsprayed, 11.88%. On October 7, 1916, the average per cent of infected leaves on sprayed trees was 6.48% and on the unsprayed trees 41.35%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 3.86% and on the unsprayed trees, 61.96%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 28.15% and the unsprayed trees, 89.28%.

LOT II-A

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	159.4 gm.
Sound beans produced by six unsprayed trees	14.46 gm.
Increase due to spraying or 90.9%.	144.94 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and the unsprayed trees were slightly infected with rust. On July 8, 1916, a sharp contrast was observed. The average per cent of infected leaves on the sprayed trees was 1.74% and on the unsprayed, 13.91%. On October 7, 1916, the average per cent of infected leaves was 9.91% and on the unsprayed trees, 38.05%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 2.62% and on the unsprayed trees, 61.09%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 31.51% and the unsprayed trees, 92.83%.

LOT II-B

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	327.6 gm.
Sound beans produced by six unsprayed trees	14.46 gm.
Increase due to spraying or 95.5%.	313.14 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 8, 1916, both the sprayed and the unsprayed trees were slightly infected with rust. On July 8, 1916, a contrast was observed. The average per cent of infected leaves on sprayed trees was found to be 2.69% and on the unsprayed, 13.91%. On October 7, 1916, the average per cent of infected leaves on unsprayed trees was 11.50% and on the unsprayed trees, 38.05%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 6.91% and on the unsprayed trees 61.09%.

The loss in leaves was determined and it was found that the sprayed trees had an average loss of 32.05% and the unsprayed trees, 92.83%.

LOT II-C

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	300.1 gm.
Sound beans produced by six unsprayed trees	14.64 gm.
Increase due to spraying	285.46 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and the unsprayed trees were slightly infected with rust. On July 8, 1916, a contrast was observed. The average per cent of infected leaves on sprayed trees was found to be 3.38% and on the unsprayed 13.91%. On October 7, 1916, the average per cent of infected leaves on the sprayed trees was 18.15% and on the unsprayed, 38.05%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 7.18% and on the unsprayed, 61.09%.

The loss in leaves was determined, and it was found that the sprayed trees had an average loss of 36.80% and the unsprayed trees, 92.83%.

LOT III-A

Effect of Spraying on Yield

Sound beans produced by six sprayed trees	256.6 gm.
Sound beans produced by six unsprayed trees	14.46 gm.
Increase due to spraying or 94.3%.	242.14 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and unsprayed trees were slightly infected with rust and on July 8, 1916, both were heavily infected. On October 7, 1916, a sharp contrast was observed. The average per cent of infected leaves on sprayed trees was found to be 14.03% and on the unsprayed 39.45%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 7.29% and on the unsprayed, 46.42%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 44.27% and the unsprayed trees, 88.26%.

LOT III-B

Effect of Spraying on Yield

Of the six sprayed trees in this group one died, so the comparison was based on five sprayed trees with six unsprayed.

Sound beans produced by 5 sprayed trees	213.4 gm.
Sound beans produced by 6 unsprayed trees	14.64 gm.
Increase due to spraying or 93.1%.	198.76 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and unsprayed trees were slightly infected with rust. On July 8, 1916, the sprayed and the unsprayed were about equally infected. On October 7, 1916, a sharp contrast was observed. The average per cent of infected leaves on the sprayed trees was found to be 28.41% and on the unsprayed, 39.45%. At the close of the experiment, February 10, 1917, the average per cent of infected leaves on the sprayed trees was 11.74% and on the unsprayed, 46.42%.

The loss in leaves was determined. It was found that the sprayed trees had an average of 45.60% and the unsprayed trees, 88.26%.

LOT III-C

Effect of Spraying on Yield

Sound beans produced by 6 sprayed trees	92.8 gm.
Sound beans produced by 6 unsprayed trees	14.46 gm.
Increase due to spraying or 84.4%.	78.34 gm.

EFFECT OF SPRAYING ON HEMILEIA

On June 3, 1916, both the sprayed and the unsprayed trees were slightly infected with rust and on July 8, 1916, both were heavily infected. On October 7, 1916, there was no distinction between the sprayed and the unsprayed trees as to *Hemileia* infection, both being heavily infected. The average per cent of infected leaves on sprayed trees was found to be 31.23% and on the unsprayed, 39.45%. At the close of the experiment, a contrast was observed. The sprayed trees had an average of 11.01% and the unsprayed, 46.42%.

The loss in leaves was determined. It was found that the sprayed trees had an average loss of 49.10% and the unsprayed trees, 88.26%.

The following series of tables (IV-VI) shows the comparative effect of spraying on the loss of leaves, on production, and on the work of *Hemileia vastatrix* on coffee trees on the college farm.

Table IV—Lot I-A	Trees sprayed with Bordeaux mixture diluted to ¾ strong, every 2 weeks.
Table IV—Lot I-B	Trees sprayed with Bordeaux mixture diluted to ¾ strong, every 3 weeks.
Table IV—Lot I-C	Trees sprayed with Bordeaux mixture diluted to ¾ strong, every 4 weeks.

Table V—Lot II-A Trees sprayed with Bordeaux mixture diluted to ½ strong, every 2 weeks.

Table V—Lot II-B Trees sprayed with Bordeaux mixture diluted to ½ strong, every 3 weeks.

Table V—Lot II-C Trees sprayed with Bordeaux mixture diluted to ½ strong, every 4 weeks.

Table VI—Lot III-A Trees sprayed with Bordeaux mixture diluted to ¼ strong, every 2 weeks.

Table VI—Lot III-B Trees sprayed with Bordeaux mixture diluted to ¼ strong, every 3 weeks.

Table VI—Lot III-C Trees sprayed with Bordeaux mixture diluted to ¼ strong, every 4 weeks.

SUMMARY

1. This experiment shows that spraying coffee trees with Bordeaux mixture is profitable. Besides the actual increase of production of berries, the trees of the sprayed lots have more leaves than the unsprayed ones. Also the next season's crop is surer in the former than in the latter.

2. The efficiency of Bordeaux as a control of *Hemileia* on coffee depends quite largely on the strength of the solution and the length of intervals between applications. Spraying with ¾ normal at intervals of two weeks and three weeks showed much more favorable results than weaker solutions at the same intervals of application. The cost incurred in using stronger solutions is greater than in weaker ones, but this is counterbalanced by the much greater production of the trees treated with stronger solutions. However, too strong a solution, though it may control the *Hemileia*, may also mean financial loss to the planter on account of the extra expense in chemicals. According to the previous experiments on normal Bordeaux carried by F. D. Luistro, (6) the cost of application per tree per year is ₱0.29. With this strength of Bordeaux the infection of *Hemileia* is almost entirely controlled, some trees being "entirely free from *Hemileia* while the others have 0.2-0.3% infection." But by using ¾ normal Bordeaux, the infection is only about 0.5% and the cost is ₱0.07 less per tree a year than the former. It is therefore quite evident that to use ¾ normal Bordeaux is much more economical than to use normal.

3. Weak Bordeaux solution, ½ normal, and below, may affect *Hemileia* infection, and therefore production, but this good effect is not enough to balance the cost of materials and the labor involved.

4. The efficiency of Bordeaux as a control for *Hemileia* on coffee also depends upon the condition of the trees when the first treatment is applied. The trees that are quite free from infection at the start are not as seriously affected by the disease as those already partially defoliated.

CONCLUSIONS

1. Out of the nine different treatments given in spraying coffee, Lot I-A, where trees were sprayed with Bordeaux diluted to ¾ strength every two weeks, showed very good results. The trees were almost entirely free from *Hemileia* infection. The per cent of leaves infected at the close of the experiment varied from 0.14% to 1.1%.

2. Trees sprayed with Bordeaux diluted to ¾ strength, every three weeks, had about the same degree of *Hemileia* infection as the trees that were sprayed with Bordeaux diluted to ½ strength, every two weeks.

3. Bordeaux mixture diluted to weaker concentrations and with application at four weeks' intervals showed a very slight effect on the *Hemileia* infection, as compared with the unsprayed trees.

4. Spraying with weak solutions of Bordeaux and at long intervals did not control the *Hemileia* to any great extent,

and it was found from the results that this is not a profitable business but only a waste of materials and labor.

5. Spraying gave its best results when it was begun before there were any signs of *Hemileia* on the trees.

6. The *Caracolillo* coffee on the college farm was earlier infected with *Hemileia* than the "native" coffee at San Antonio.

7. Only two of the sprayed lots showed net profit in spraying. Lot I-A gave at the rate of ₱13.58 and Lot I-B, ₱38.80. These trees were in Los Baños.

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Tetrameres fissispina (Diesing, 1860) in Philippine Chickens

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In October, 1917, Professor Charles S. Banks brought me a number of Nematode worms which had been collected from the proventriculus of a chicken at the College of Agriculture in Los Baños. On examination these worms were found to belong to the genus *Tetrameres* Creplin, 1846. This genus contains 13 species of worms all of which have been found in the digestive tract of birds. However only one species, *Tetrameres fissispina* (Diesing, 1860) has been recorded as a parasite of chickens, Dr. Lauro Travassos having reported it from this host in Brazil in 1914.[1] Further study of the specimens furnished by Prof. Banks and of others which I have obtained here in Manila has led to the conclusion that the Philippine species is identical with that reported by Dr. Travassos.

TETRAMERES FISSISPINA (DIESING, 1860).)

Syn.

Tropidocerca fissispina Diesing, 1860.
Acanthophorus tenuis v. Linstow, 1876.
Acanthophorus horridus v. Linstow, 1876.
Tropidocerca inflata Zuern, 1882, nec Diesing, 1860.
Tropisorus fissispinus Neumann, 1888.
Tropisurus fissispinus Railliet, 1895.

All the species of this genus are remarkable for their great sexual dimorphism, the males being long, slender, white worms and the females subglobular and red or brown.

Female.

Length, 3 to 6 mm. Diameter, 2 to 3.5 mm.

Body subglobular, blood red with slender, conical cephalic and caudal projections. The body is transversely striated and bears four longitudinal depressions which correspond to the median and lateral lines. The two extremities are more or less retractile and movable from side to side, the anterior or cephalic projection measuring 1.2 mm. in length and the posterior, 0.5 to 0.9 mm.

The mouth is at the end of the cephalic projection and is surrounded by three lips each of which bears a terminal papilla. It opens into a rounded buccal cavity about 20 microns in diameter. The oesophagus extends throughout the length of the projection and opens into a large sac-like intestine which extends through the body and into the caudal projection where it opens about 0.2 mm. from the posterior end. The intestine generally contains a mass of black coloring matter, so that it can easily be followed through the body. At the junction of the oesophagus with the intestine is a mass of unicellular glands.

The genital organs occupy the greater part of the body and consist of a mass of much coiled and twisted tubes. The uteri are double and unite to form a long vagina which opens ventrally at the junction of the caudal extremity with the body and just a short distance in front of the anus. Just anterior to the opening there is a round, sac-like diverticulum of the vagina. The uterus and the vagina, with its diverticulum, are always filled with eggs in different stages of segmentation. The eggs are oval and thin shelled and measure 48 to 56 microns in length by 26 to 30 microns in diameter. They contain a coiled embryo when they are ready to be laid.

[1] Travassos, Dr. Lauro.
Sobre as especies brazilieras do genero Tetrameres Creplin, 1846. Memorias do Instituto Oswaldo Cruz, Tomo VI, 1914, pp. 150-162.

Male.

Length, 4 to 5 mm. Diameter, 0.11 to 0.2 mm.

The body is thread-like, white and is transversely striated. Along each lateral and median line is a single row of small spines which point backward. These spines begin just back of the buccal cavity and extend beyond the level of the anus. In the anterior and posterior regions they are about 20 microns apart but in the middle of the body they are separated by as much as 115 microns.

The alimentary canal is distinctly different in the male. It is divided into a short buccal capsule, an oesophagus, composed of a short slender anterior portion and a long wide posterior portion which opens into a slender tube-like intestine. The latter does not have the black color of the female intestine. The anus opens at about 0.25 mm. from the tip of the tail.

There are two unequal spicules, a short sharp pointed one 115 microns long and about 4 microns in thickness and a long one 320 microns long and 15 microns in thickness, with a rounded end.

Habitat.

The female worms lie embedded in the gastric glands of the proventriculus. They can be seen from the outside as small round red spots in the walls. The males either lie free in the lumen of the proventriculus or with one end buried in the duct of a gastric gland.

Host.

Tetrameres fissispina has been reported from the mud hen (*Fulica atra*), the duck (*Anas boscas*) and the chicken (*Gallus domesticus*). Since receiving the specimens from Prof. Banks I have examined 26 chickens here in Manila and have found the worms in 13 or 50% of them. Prof. Banks tells me that he saw it in only two chickens examined in Los Baños. Here in Manila it is by far the most common parasite found in chickens.

Pathogenicity.

None of the chickens which I have examined have shown any external evidence of pathological conditions which could be traced to the presence of the worms in the walls of the alimentary tract. However, I believe that the presence of these worms, particularly in young chickens, might very probably lessen the vitality to such an extent that they would fall easy victims to other epidemic diseases.

Treatment and Prophylaxis.

The fact that the females of this species live in the walls of the canal would make the use of ordinary anthelmintics of no avail and I know of no method of treatment which would reach and destroy them. As the life history of the worm is not known at the present time, the measures which could be used to prevent infestation would have to be very general. These would include the burning or disinfection of all droppings and the killing of all chickens which were shown to be infested, by a microscopical examination of the feces for eggs. In flocks which are known to be badly infested it would be advisable to place all newly hatched chicks in a separate inclosure from which all possibly infected chickens had been excluded for some months.